A2197 + A2199 SUPERCLUSTER REGION

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A2197 and A2199 are among the nearest rich clusters of galaxies. They are worthy of special attention because (i) they form a close binary system, the analysis of which provides an independent estimate of the clusters' mass to light ratio, and (ii) these two clusters fall along a bridge of interconnected clusters that stretches at least 50 Mpc. We report 78 new redshifts in the A2197+A2199 region, thus tripling the number of known redshifts.

The A2197+A2199 group is located 25° north of the Hercules cluster group. Because both groups have similar mean redshifts ($z=0.0309$ for the former and $z=0.0360$ for the latter), Chincarini, Rood, and Thompson (1981) searched the intervening area of sky for galaxies with $z\sim0.030$. These observations showed that a bridge of galaxies links the two regions. While making new observations in the A2197+A2199 area, we probed a 72 square degree region further to the north. Five additional galaxies with redshifts $z\sim0.030$ were identified, as many as would be expected if the bridge continues northward at least another 10°.

The binary nature of A2197+A2199 provides the means to determine the system's total mass to light ratio (M/L) independent of virial techniques. We use a formalism which was introduced by Peebles (1974) and Gunn (1974) and originally applied to the Local Group. Since the equations contain one too many unknowns to fully specify a solution, we calculate the binary cluster's M/L as a function of the angle α between the plane of the sky and the line connecting the cluster centers. While high values of M/L are permissible if $\alpha<5°$ or $\alpha>75°$, all intermediate values of α require $M/L<200$. If $13°<\alpha<62°$ then $M/L<50$. This stands in contrast to results commonly obtained for rich cluster cores via the virial theorem (for the A2199 core we find $M/L\sim185$-225). In all likelihood, high M/L ratios are characteristic only of cluster cores, and the outskirts of rich clusters may show lower M/L ratios.

Chincarini, G., Rood, H., and Thompson, L. 1981, Ap.J.Lett., 249, L47.
Gunn, J. 1974, Comments Ap. & Space Phys., 6, 7.
Peebles, P.J.E. 1971, Physical Cosmology (Princeton Univ. Press).

G. O. Abell and G. Chincarini (eds.), Early Evolution of the Universe and Its Present Structure, 291–292.

Discussion

Shandarin: Why do you think these clusters are gravitationally bound?

Thompson: If the double cluster is modeled with the equations appropriate for an unbound system, the solution requires a very low mass for the double cluster. In that case, $M/L < 5.1$.

Salpeter: If massive neutrinos are dominant, one could have both a large M/L and the small deviation ΔV from the Hubble expansion which you observe: ΔV would be small if the neutrinos in the supercluster extend beyond the region where the cluster cores are, with smaller density contrast than for galaxies.

Thompson: I agree that this is one possible explanation. However, before making any wide-ranging conclusions, other close binary clusters must be observed to insure that the A2197+A2199 system is telling us the right value for M/L.

Peacock: It may well be that by selecting close pairs on the sky you are biased towards angles close to the line of sight. High M/L is then not so improbable.

Thompson: If the clusters selected for study are widely separated from one another in the line of sight ($\alpha \geq 75°$), then their galaxy luminosity functions should show the difference in distance. Preliminary data for A2197 and A2199 indicate that these two clusters do not suffer from this effect. However, anyone who selects other pairs for similar analysis must take your advice into account.

Einasto: This double cluster is a part of a very long cluster filament (Hercules supercluster) which is seen almost in the plane of the sky. The method used is very sensitive to small changes in projection angle, α, in this particular case, and therefore the result has low weight.

Thompson: In fact, the filament you speak of is tilted off the plane of the sky by 26°. If the angle α for the A2197 + A2199 system is the same as the filament (i.e., $\alpha = 26°$), then the solution has high weight and $M/L < 50$. However, I think it is not advisable to presume that such a close binary would necessarily fall along the filament.

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